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(54) **SYSTEM AND DEVICE FOR WELDING TRAINING**

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(58) **Field of Classification Search**

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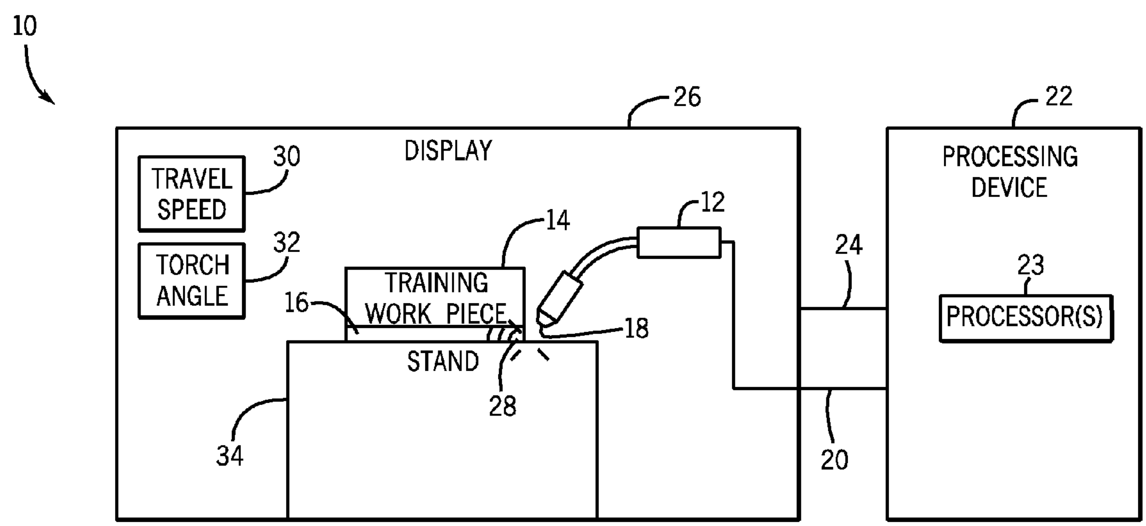
(57) **ABSTRACT**

A system and device for welding training. In one example, a welding training system includes a display configured to show welding features related to a training welding operation. The system also includes a training workpiece having a substantially transparent weld joint configured to be placed adjacent to the display during the training welding operation. The system includes a processing device coupled to the display and configured to provide welding data relating to the training welding operation to the display. The system also includes a training torch comprising an optical sensor. The training torch is coupled to the processing device and configured to provide the processing device with data from the optical sensor corresponding to a position of the training torch relative to the training workpiece.

18 Claims, 4 Drawing Sheets



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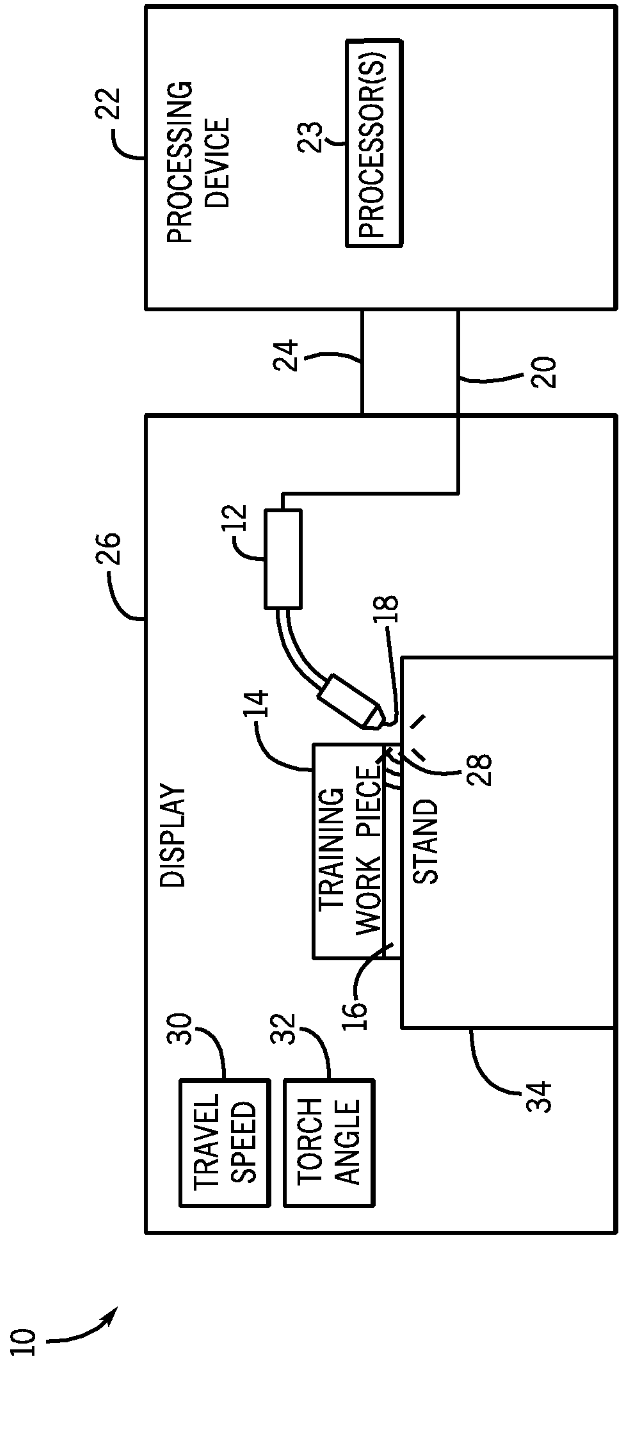
PROCESSING DEVICE
22
PROCESSOR(S)
23
24
20
DISPLAY
26
12
18
14
TRAINING WORK PIECE
STAND
28
16
30
TRAVEL SPEED
32
TORCH ANGLE
34
10

FIG. 1

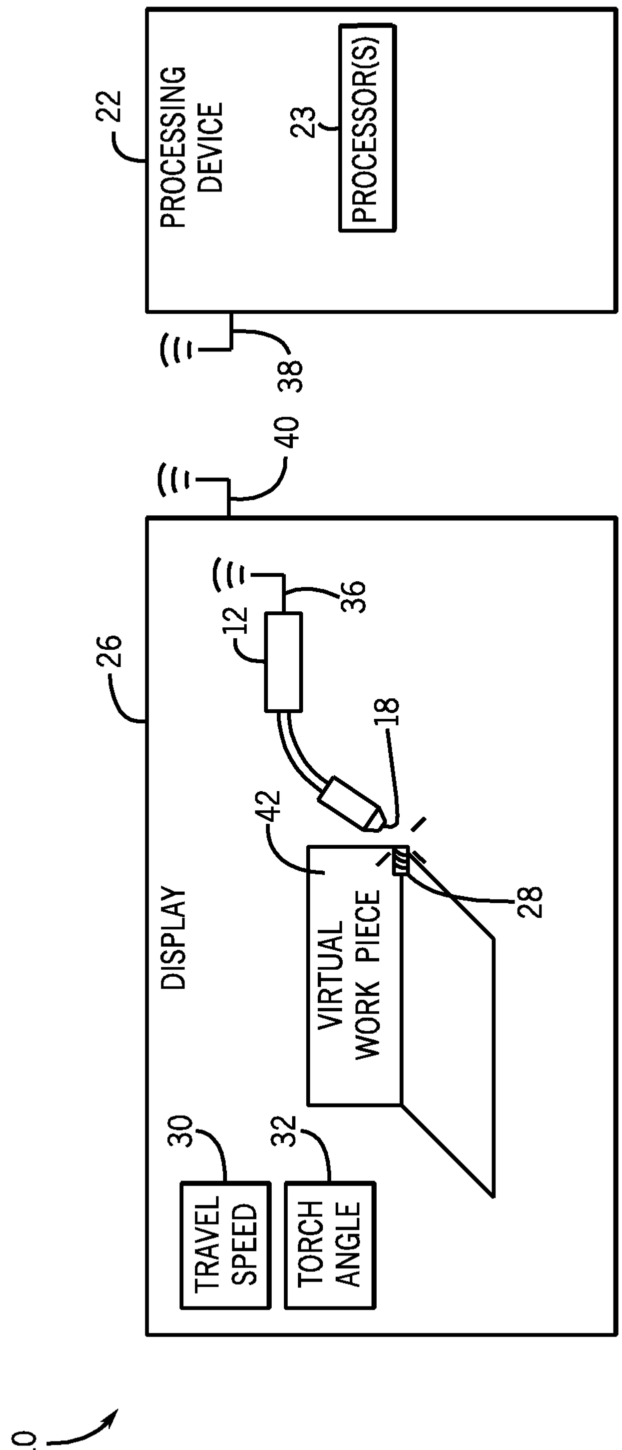
22
PROCESSING DEVICE
23
PROCESSOR(S)
38
40
26
DISPLAY
12
36
18
42
VIRTUAL WORK PIECE
28
30
TRAVEL SPEED
32
TORCH ANGLE
10

FIG. 2

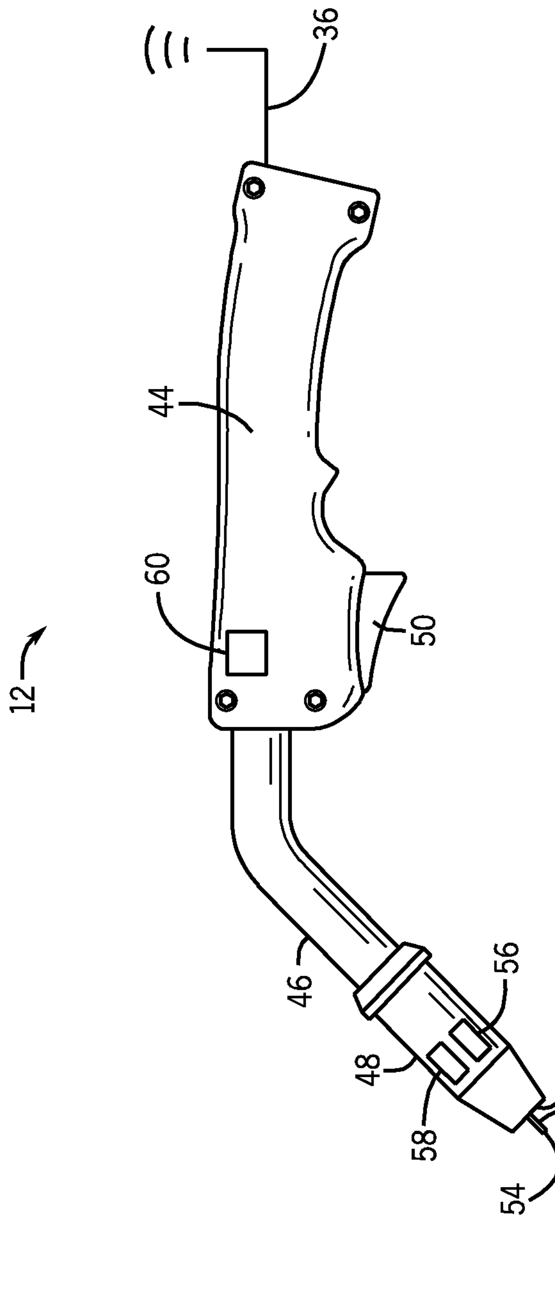

FIG. 3

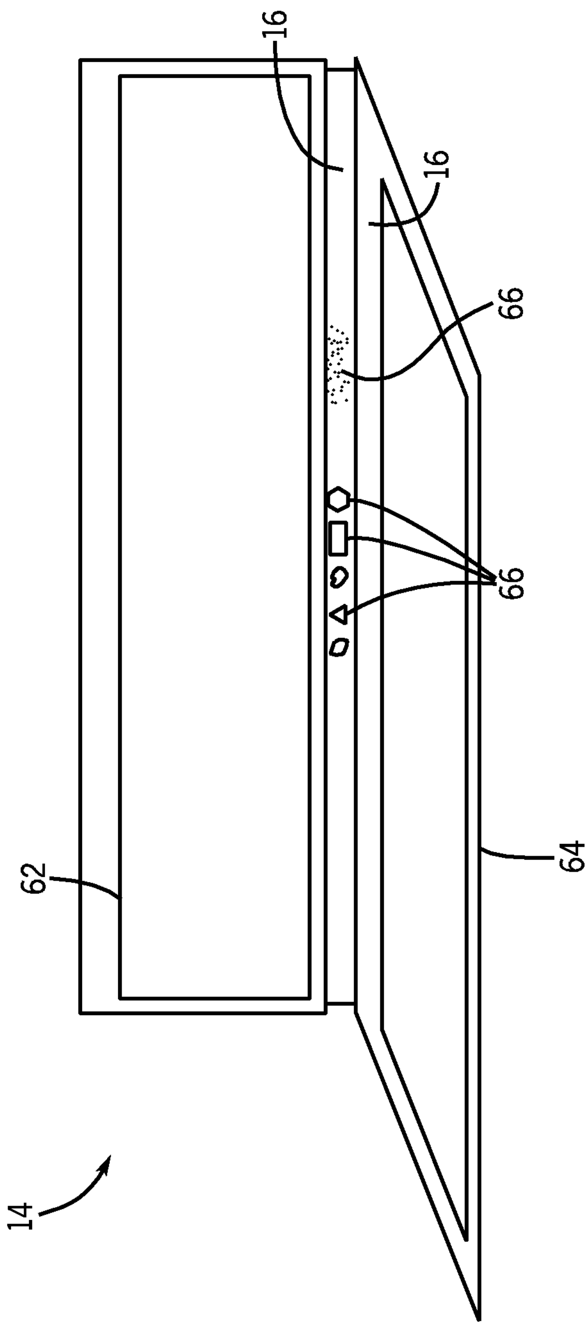

FIG. 4

SYSTEM AND DEVICE FOR WELDING TRAINING

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Non-Provisional Patent Application of U.S. Provisional Patent Application No. 61/521,843 entitled "Tracking Gun for Training," filed Aug. 10, 2011, which is herein incorporated by reference in its entirety.

BACKGROUND

The invention relates generally to welding and, more particularly, to a system and device for welding training.

Welding is a process that has increasingly become utilized in various industries and applications. Such processes may be automated in certain contexts, although a large number of applications continue to exist for manual welding operations. In both cases, such welding operations rely on a variety of types of equipment to ensure the supply of welding consumables (e.g., wire feed, shielding gas, etc.) is provided to the weld in appropriate amounts at the desired time.

In preparation for performing manual welding operations, welding operators may be trained using a welding training system. The welding training system may be designed to train welding operators with the proper techniques for performing various welding operations. Certain welding training systems may use virtual reality, augmented reality, or other training methods. As may be appreciated, these training systems may be expensive to acquire and operate. Accordingly, welding training institutions may only acquire a limited number of such training systems. Therefore, welding operators being trained by the welding training institutions may have a limited amount of time for hands-on training using the training systems.

BRIEF DESCRIPTION

In one embodiment, a welding training system includes a display configured to show welding features related to a training welding operation. The system also includes a training workpiece having a substantially transparent weld joint configured to be placed adjacent to the display during the training welding operation. The system includes a processing device coupled to the display and configured to provide welding data relating to the training welding operation to the display. The system also includes a training torch comprising an optical sensor. The training torch is coupled to the processing device and configured to provide the processing device with data from the optical sensor corresponding to a position of the training torch relative to the training workpiece.

In another embodiment, a welding training system includes a training workpiece having a substantially transparent weld joint configured to be placed adjacent to a display during a training welding operation such that a portion of the display is visible by looking through the substantially transparent weld joint. The system also includes a training torch having a sensor configured to detect data corresponding to a position of the training torch relative to the training workpiece during the training welding operation.

In another embodiment, a welding training system includes a processing device coupled to a display and configured to provide welding data relating to a training welding operation to the display. The system also includes a training torch having an optical sensor. The training torch is coupled to the processing device and configured to provide the processing device with data from the optical sensor corresponding to a position of the training torch relative to a training workpiece.

DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

FIG. **1** is a block diagram of an embodiment of a welding training system in accordance with aspects of the present disclosure;

FIG. **2** is block diagram of another embodiment of a welding training system in accordance with aspects of the present disclosure;

FIG. **3** is a side view of an embodiment of a training torch in accordance with aspects of the present disclosure; and

FIG. **4** is a perspective view of an embodiment of a training workpiece in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

FIG. **1** is a block diagram of an embodiment of a welding training system **10**. The welding training system **10** includes a training torch **12** that may be used for training a welding operator in various welding techniques. The welding training system **10** also includes a training workpiece **14** having a substantially transparent weld joint **16**. The weld joint **16** may simulate a weld joint formed during a welding operation (e.g., fillet, lap, butt, groove, etc.). The training torch **12** includes an optical sensor **18** (e.g., camera) that may be used to detect image data (e.g., from the training workpiece **14**). In certain embodiments, the detected image data may correspond to a location of the training torch **12** relative to the training workpiece **14**. For example, a welding operator may direct the training torch **12** toward the weld joint **16** of the training workpiece **14**. The optical sensor **18** of the training torch **12** may then detect image data from the weld joint **16** that may be used to determine a position of the training torch **12** relative to the training workpiece **14**.

A first wired interface **20** electrically couples the training torch **12** to a processing device **22** having one or more processor(s) **23**. After the training torch **12** detects image data, the training torch **12** provides the image data (e.g., data corresponding to the training workpiece **14**, data corresponding to a position of the training torch **12** relative to the training workpiece **14**) to the processing device **22** for processing. The processing device **22** may use the image data to determine a position of the training torch **12** relative to the training workpiece **14**. A second wired interface **24** electrically couples the processing device **22** to a display **26**. Accordingly, the processing device **22** may provide welding data to the display **26** for showing images of welding features that correspond to a welding training operation being performed by a welding operator. For example, the display **26** may show a virtual weld bead **28** corresponding to the welding training operation.

As illustrated, the virtual weld bead **28** may be shown on the display **26** behind the weld joint **16** of the training workpiece **14**. As may be appreciated, the processing device **22** may use the determined position of the training torch **12** relative to the training workpiece **14**, and a corresponding position of the training workpiece **14** relative to the display **26** to determine where to show the virtual weld bead **28**. In certain embodiments, the processing device **22** may be configured to account for a refresh rate of the display **26** and/or lighting conditions (e.g., glare) while processing image data detected by the training torch **12**. The display **26** may show other parameters relating to the training welding operation in addition to the virtual weld bead **28**. For example, the display **26** may show a travel speed **30** and/or a torch angle **32** (e.g., travel angle, work angle, torch orientation, etc.). As illustrated, the training workpiece **14** is placed adjacent to the display **26** (e.g., touching the display, within ⅛ inch of the display, etc.) during a training welding operation.

A stand **34** may be configured for and used to support the training workpiece **14**. As may be appreciated, in certain embodiments, the stand **34** may also be used to calibrate the location of the training workpiece **14** relative to the display **26** (e.g., by the stand **34** and the display **26** being placed in a predetermined location in relation to each other). In other embodiments, the location of the training workpiece **14** relative to the display **26** may be manually calibrated (e.g., before a training welding operation is performed). For example, the welding operator may be instructed to touch an end of the training torch **12** to one or more predetermined locations on the training workpiece **14**, which may allow the processing device **22** to determine a location of the training workpiece **14** relative to the display **26**. During such a calibration, the display **26** may show a configuration pattern to enable the optical sensor **18** of the training torch **12** to detect image data corresponding to a position on the display **26**. Using the training torch **12** with the optical sensor **18**, the welding training system **10** enables a welding operator to be trained with a minimal amount of specialized training devices. Accordingly, by using the welding training system **10** a welding operator may receive welding training at a lower cost than possible with other welding training systems.

FIG. **2** is block diagram of another embodiment of the welding training system **10**. In this embodiment, the training torch **12**, the processing device **22**, and the display **26** communicate via wireless interfaces **36**, **38**, and **40**. As may be appreciated, in certain embodiments, the welding training system **10** may communicate via a combination of wired and wireless interfaces. Furthermore, in some embodiments, the training torch **12** may provide data to the processing device **22** using a universal serial bus (USB) interface. As illustrated, a virtual workpiece **42** may be used in place of the training workpiece **14**. Accordingly, the optical sensor **18** of the training torch **12** may detect image data directly from the display **26**. In certain embodiments, the image data may correspond to a location of the training torch **12** relative to the virtual workpiece **42** and/or the display **26**. Using the virtual workpiece **42**, a welding operator may perform virtual welds on the display **26** by placing the optical sensor **18** of the training torch **12** near the virtual workpiece **42**. In certain embodiments, the display **26** may be configured for three-dimensional viewing. In such an embodiment, the welding operator may wear three-dimensional glasses while performing welding training operations. It should be noted that the wireless interfaces **36**, **38**, and **40** and/or the virtual workpiece **42** may enable welding training to be performed with less interference from cables and other training devices.

FIG. **3** is a side view of an embodiment of a training torch **12** configured to be used in the welding training system **10** of FIG. **1**. As previously discussed, the training torch **12** is configured to detect image data using the optical sensor **18**. In the present embodiment, the training torch **12** includes a handle **44**, a neck **46**, and a nozzle **48**. Furthermore, the handle **44** includes a trigger **50** for initiating a training welding operation. As illustrated, the handle **44** is coupled to the nozzle **48** via the neck **46**. The optical sensor **18** may extend out of a tip **52** of the nozzle **48**. Moreover, the optical sensor **18** may include one or more lenses **54** (e.g., adjustable lenses) to change the focal point of the optical sensor **18** (e.g., to obtain clear and focused image data). In certain embodiments, the optical sensor **18** may be configured to alter the focus of the one or more lenses **54** based on a distance between the optical sensor **18** and the training workpiece **14**, and/or a distance between the optical sensor **18** and the virtual workpiece **42**. Furthermore, the one or more lenses **54** may include a multi-surface lens (e.g., diamond shaped).

The training torch **12** also includes an optical emitter **56** configured to produce emissions. In certain embodiments, the emissions from the optical emitter **56** may reflect off of the training workpiece **14** and/or the virtual workpiece **42**. As may be appreciated, the reflected emissions may be detected by the optical sensor **18** of the training torch **12**. Moreover, in the illustrated embodiment, the training torch **12** includes a magnetic sensor **58**, while in other embodiments, the training torch **12** may not include the magnetic sensor **58**. The magnetic sensor **58** may be used in a welding training system **10** having corresponding magnetic devices to be detected by the magnetic sensor **58** (e.g., for determining the position of the training torch **12**. For example, in certain embodiments, the training workpiece **14** may produce a magnetic field and the magnetic sensor **58** may be configured to detect the magnetic field of the training workpiece **14**. Furthermore, the training torch **12** may include an orientation sensor **60** (e.g., gyroscope) to detect orientation data of the training torch **12** and to provide the orientation data to the processing device **22**. It should be noted that in certain embodiments, the training torch **12** may include an electromagnetic sensor, a radio frequency (RF) sensor, and/or any other suitable sensor to aid in determining a position and/or an orientation of the training torch **12** relative to a workpiece (e.g., the training workpiece **14**, the virtual workpiece **42**).

FIG. **4** is a perspective view of an embodiment of the training workpiece **14** that may be used with the training system **10**. The training workpiece **14** includes the substantially transparent weld joint **16**, as illustrated. Furthermore, the training workpiece **14** includes a vertical portion **62** and a horizontal portion **64**. Moreover, the weld joint **16** is positioned at the intersection of the vertical potion **62** and the horizontal portion **64**. In the present embodiment, the weld joint **16** includes a pattern **66** (e.g., shapes, dots, curves, numbers, letters, etc.) configured to be detected by the optical sensor **18** of the training torch **12**. For example, the substantially transparent weld joint **16** may include a pattern **66** such that the optical sensor **18** may determine what portion of the training workpiece **14** is being detected based on the detected image data of the pattern **66**. The pattern **66** may be imbedded within the weld joint **16** and/or may provide external texture to the weld joint **16**.

As may be appreciated, using the systems, devices, and techniques described herein, a low cost welding training system **10** may be provided for training welding operators. The welding training system **10** may allow a greater number of welding operators to be trained and may provide the welding operators with a greater amount of time to use the welding training system **10** (e.g., due to its low cost). Furthermore, as described above, welding operators may receive feedback (e.g., torch angle, travel speed, etc.) while operating the welding training system **10** to improve welding techniques.

While only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

The invention claimed is:

1. A welding training system comprising:

a display configured to show welding features related to a training welding operation;

a training workpiece comprising a substantially transparent weld joint configured to be placed adjacent to the display during the training welding operation such that a portion of the display is visible by looking through the substantially transparent weld joint;

a processing device coupled to the display and configured to provide welding data relating to the training welding operation to the display; and

a training torch comprising an optical sensor, wherein the training torch is coupled to the processing device and configured to provide the processing device with data from the optical sensor corresponding to a position of the training torch relative to the training workpiece.

2. The system of claim 1, wherein the display is configured to show a virtual weld bead of the training welding operation behind the substantially transparent weld joint of the training workpiece.

3. The system of claim 1, wherein the display is configured to show a travel speed and/or a torch angle of the training welding operation.

4. The system of claim 1, comprising a stand configured to support the training workpiece.

5. The system of claim 1, wherein the substantially transparent weld joint comprises a pattern configured to be detected by the optical sensor.

6. The system of claim 1, wherein the optical sensor comprises a camera configured to receive image data corresponding to the training workpiece.

7. The system of claim 6, wherein the camera comprises an adjustable lens to change a focal point of the camera.

8. The system of claim 6, wherein the camera is configured to alter a camera focus based on a distance between the camera and the training workpiece.

9. The system of claim 1, wherein the optical sensor is configured to detect image data shown on the display.

10. The system of claim 1, wherein the training torch comprises an optical emitter, and wherein the optical sensor of the training torch is configured to detect emissions from the optical emitter after the emissions reflect off of the training workpiece.

11. A welding training system comprising:

a training workpiece comprising a substantially transparent weld joint configured to be placed adjacent to a display during a training welding operation such that a portion of the display is visible by looking through the substantially transparent weld joint; and

a training torch comprising a sensor configured to detect data corresponding to a position of the training torch relative to the training workpiece during the training welding operation.

12. The system of claim 11, wherein the sensor comprises a magnetic sensor configured to detect a magnetic field of the training workpiece.

13. The system of claim 11, wherein the sensor comprises a gyroscope configured to detect an orientation of the training torch.

14. The system of claim 13, wherein the display is configured to show the orientation of the training torch during the training welding operation.

15. The system of claim 11, wherein the display is configured to show a virtual weld bead formed during the training welding operation behind the substantially transparent weld joint of the training workpiece.

16. A welding training system comprising:

a processing device coupled to a display and configured to provide welding data relating to a training welding operation to the display, wherein the display is configured to show a virtual workpiece; and

a training torch comprising an optical sensor, wherein the training torch is coupled to the processing device and configured to provide the processing device with data from the optical sensor corresponding to a position of the training torch relative to a training workpiece, wherein the training workpiece comprises the virtual workpiece.

17. The system of claim 16, wherein the training torch comprises an optical emitter, and wherein the optical sensor of the training torch is configured to detect emissions from the optical emitter after the emissions reflect off of the training workpiece.

18. The system of claim 16, wherein the training torch is configured to detect a weld joint on the virtual workpiece present on the display.

* * * * *